CHAPTER 1

GENERAL

1-1. Purpose and scope. This manual provides design criteria for water storage requirements at Army mobilization facilities, gives a typical design analysis for tanks and reservoirs, and provides guidance on the procedures to be followed in selecting sites for such storage works. The manual covers requirements for treated water storage in the distribution system, but not the storage requirements for raw water supplies or fire deluge systems.

1-2. Definitions. Definitions will be as defined in EM 1110-3-160.

1-3. Objectives of storage. Storage should meet peak flow requirements, equalize system pressures, and provide emergency water supply. The water supply system must provide flows of water sufficient in quantity to meet all points of demand in the distribution system.

a. Peak flow requirements. Water supply systems must be designed to satisfy maximum anticipated water demands. The peak demands usually occur on hot, dry, summer days when larger than normal amounts of water are used for personal purposes and washing vehicles and equipment. In addition, most industrial processes, especially those requiring supplies of cooling water, experience greater evaporation on hot days, thus requiring more water. The water treatment plant can operate at a relatively uniform rate throughout the day of maximum demand if enough storage is available to handle variations in water use. The necessary storage can be provided in elevated, ground, or a combination of both types of storage.

b. Equalization of system pressures. Without storage, demand on the water system must be met by the ability of the treatment plant to process and pump water. Since demand can be so variable, the flow through the plant would vary significantly. This is not very well suited to efficient functioning of the treatment or pumping units. Elevated storage within the distribution system permits treatment units and distribution pumps at the plant to operate at uniform rates. The usefulness of elevated storage is shown in figure 1-1. The system illustrated in figure 1-1(A) (without elevated storage) requires storage at the plant sufficient to provide for system demand rates in excess of the plant production rate, assuming the plant is operated at a uniform rate. The pump station forces water into the service main, through which it is carried to three load areas: A, B, and C. Since all loads on the system are met without the use of elevated storage, the pump station must be capable of supplying the peak rates of water use to Areas A, B, and C, simultaneously, while maintaining the water pressure to Area C at a sufficient level. Figure 1-1(B) assumes the construction of an elevated storage tank on the service main between Areas B and C, with peak loads in Area C and part of the peak load in

Area B being satisfied from this tank. The elevation of the tank insures adequate pressures within the system. The storage in the tank is replenished when water demands are low and the pump station can fill the tank while still meeting all flow and pressure requirements in the system. The figure 1-1(B) arrangement reduces required capacity of the distribution pumps. Most elevated storage tanks "float" on the distribution system. That is, the elevated tank is hydraulically connected to the distribution system, and the volume of water in the tank tends to maintain system pressures at a uniform level. When water use is high and pumping facilities cannot maintain adequate pressures, water is discharged from elevated tanks. Conversely, when water use is low, the pumps, which operate within a reasonably uniform head-capacity range, supply excess water to the system, and the elevated storage is refilled.

c. Distribution system pressures. Pressures in the distribution system will be in accordance with EM 1110-3-160, chapter 4.

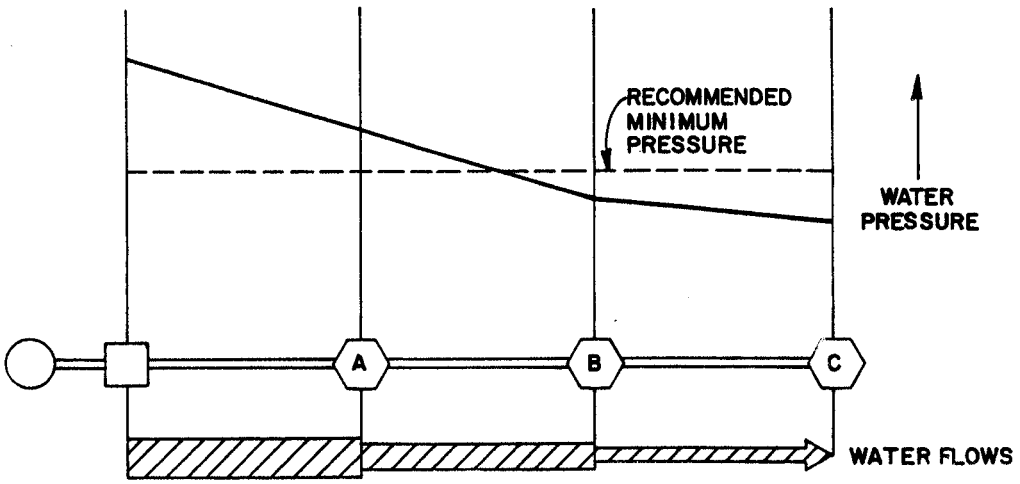
d. Provision of emergency water supplies.

(1) Firefighting flows. This demand can occur at any time, but may well coincide with other large water demands on the system. Necessary flows for firefighting purposes at mobilization sites are given in EM 1110-3-166. Storage and distribution facilities will include capacity for required firefighting flows at adequate pressures at any point of the installation.

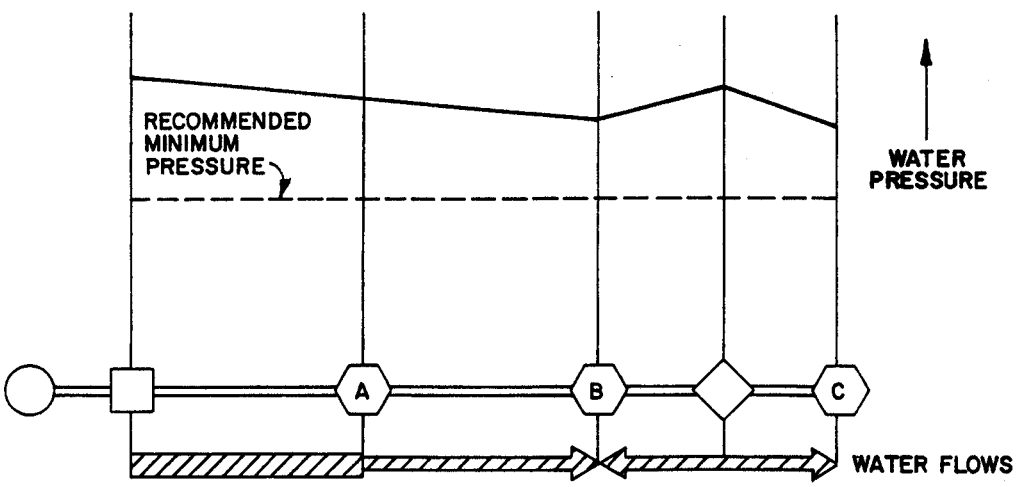
(2) Other emergencies. Water storage must provide an emergency supply of water in the event the water treatment plant, distribution pumps, or a principal transmission main is out of service. The amount of emergency storage required depends on the reliability of the system and the extent of other safeguards incorporated into the system, for example, finished water or interconnections with a municipality (for either normal or emergency use).

1-4. Location of storage facilities.

a. Elevated storage. Elevated storage tanks should be located in the areas having the lowest system pressures during intervals of high water use to be effective in maintaining adequate system pressures and flows during periods of peak water demand. These are those of greatest water demand or those farthest from pump stations. Elevated tanks are generally located at some distance from the pump station(s) serving a distribution pressure level, but not outside the boundaries of the service area, unless the facility can be placed on a nearby hill. Additional considerations for siting of elevated storage are conditions of terrain, suitability of subsurface soil and/or rock for foundation purposes, and hazards to low-flying aircraft. Elevated tanks are built on high ground to minimize the required construction cost and heights. The heights of elevated tanks should not be excessive. This will lead



(A) WATER FLOWS AND PRESSURES WITHOUT ELEVATED STORAGE



(B) WATER FLOWS AND PRESSURES WITH ELEVATED STORAGE

LEGEND

Water Treatment Plant

Pump Station and Pumped Storage

Demand Load Center

Elevated Storage

U. S. Army Corps of Engineers

FIGURE 1-1. EFFECTS OF ELEVATED STORAGE

to higher pressures than required in low-lying areas as well as increased pumping costs.

b. Ground storage. Ground storage tanks or reservoirs, below ground, partially below ground, or constructed above ground level in the distribution system, must be accompanied by pump stations. In a single pressure level system, ground storage tanks should be located in the areas having the lowest system pressures during periods of high water use. In multiple pressure level systems, ground storage tanks are usually located at the interface between pressure zones with water from the lower pressure zones filling the tanks and being passed to higher pressure zones through adjacent pump stations.